US009190747B2

(12) **United States Patent**
Tateishi

(10) **Patent No.: US 9,190,747 B2**
(45) **Date of Patent: Nov. 17, 2015**

(54) **CIRCUIT-TERMINAL CONNECTING DEVICE**

(71) Applicant: **DAI-ICHI SEIKO CO., LTD.**, Kyoto (JP)

(72) Inventor: **Jin Tateishi**, Ogoori (JP)

(73) Assignee: **Dai-Ichi Seiko Co., Ltd.**, Kyoto (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/450,662**

(22) Filed: **Aug. 4, 2014**

(65) **Prior Publication Data**

US 2015/0044887 A1 Feb. 12, 2015

(30) **Foreign Application Priority Data**

Aug. 8, 2013 (JP) 2013-164918

(51) **Int. Cl.**

H01R 12/62 (2011.01)
H01R 12/70 (2011.01)
H01R 12/71 (2011.01)
H01R 12/79 (2011.01)

(52) **U.S. Cl.**

CPC ***H01R 12/7017*** (2013.01); ***H01R 12/716*** (2013.01); ***H01R 12/79*** (2013.01)

(58) **Field of Classification Search**

CPC H05K 3/365; H05K 1/118; H05K 3/326; H01R 12/62; H01R 23/725; H01R 9/096

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,370,552	A *	12/1994	Chishima et al.	439/495
6,811,431	B2 *	11/2004	Hsieh	439/495
7,374,435	B2 *	5/2008	Idenishi	439/77
7,654,829	B1 *	2/2010	Chuang et al.	439/67
7,766,666	B1 *	8/2010	Chen et al.	439/65
2007/0224848	A1 *	9/2007	Takashita	439/67
2008/0026609	A1 *	1/2008	Kuwana et al.	439/74

FOREIGN PATENT DOCUMENTS

JP	H06-068940	A	3/1994
JP	H08-031526	A	2/1996
JP	2003-297465	A	10/2003
JP	2012-252912	A	12/2012

* cited by examiner

Primary Examiner — Gary Paumen
(74) *Attorney, Agent, or Firm* — Studebaker & Brackett PC

(57) **ABSTRACT**

A circuit-terminal connecting device comprising an electrical connector having an insulated housing mounted on a main circuit board and a plurality of resilient contacts arranged on the insulated housing, and a flat circuit member having a reinforced portion attached to a reinforcing board member operative to engage with the insulated housing of the electrical connector, wherein each of the resilient contacts has a board connecting portion provided to be connected to a first circuit-terminal provided on the main circuit board, a fixable portion provided to be fixed to the insulated housing, and a resilient arm portion extending from the fixable portion and provided with a contact point for coming into press-contact with a second circuit-terminal provided on the reinforced portion of the flat circuit member and a locking portion for engaging with the reinforcing board member to lock the same.

4 Claims, 7 Drawing Sheets

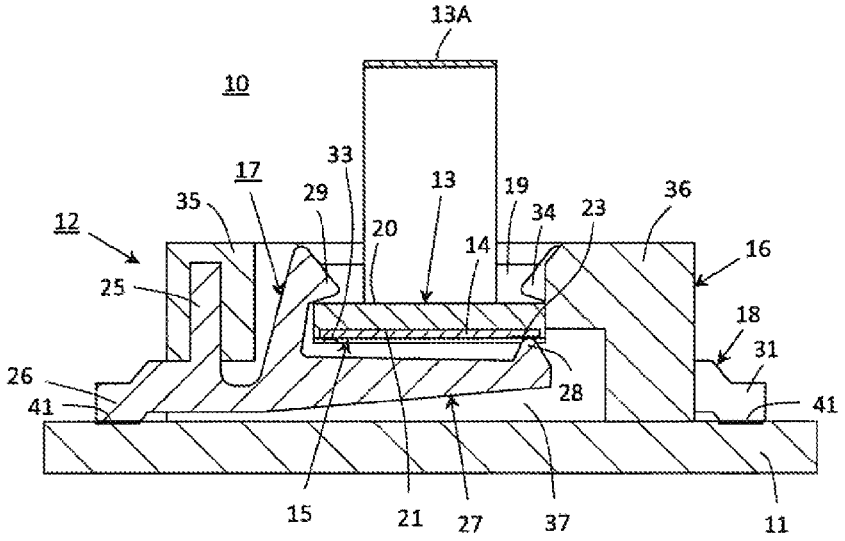


FIG. 1

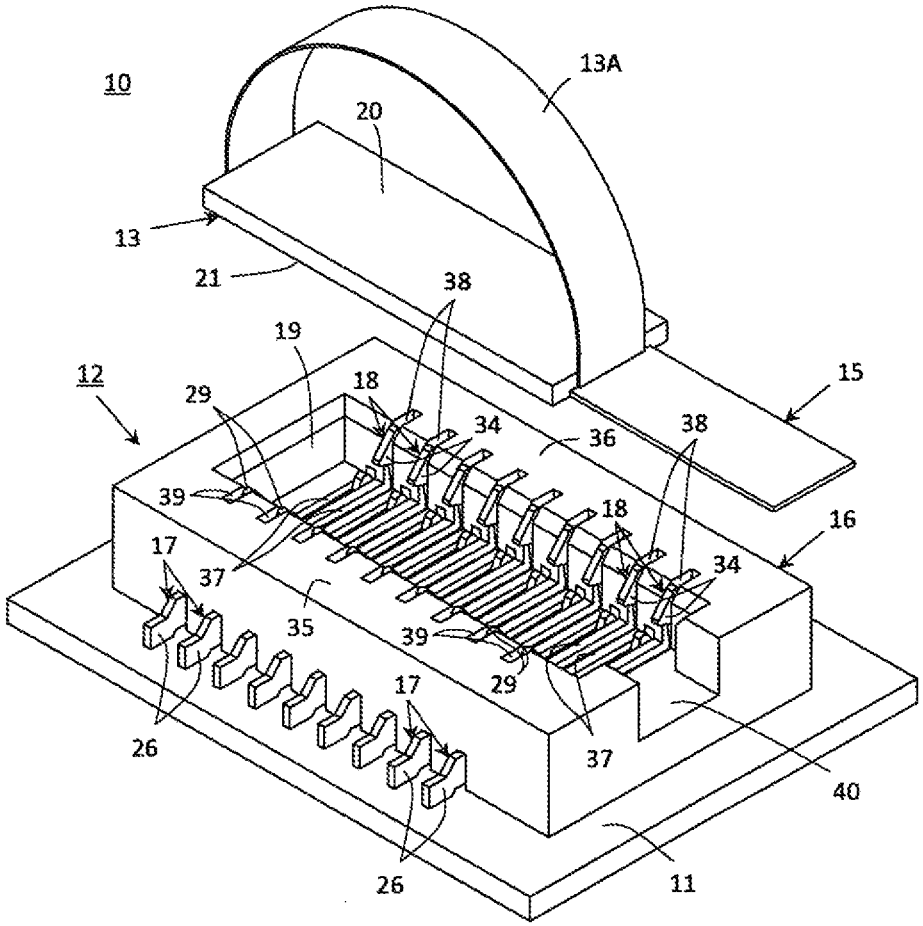

10
13A
20
13
21
38
19
12
29
18
34
36
38
15
39
18
16
17
37
34
35
39
29
17
26
37
40
26
11

FIG. 2

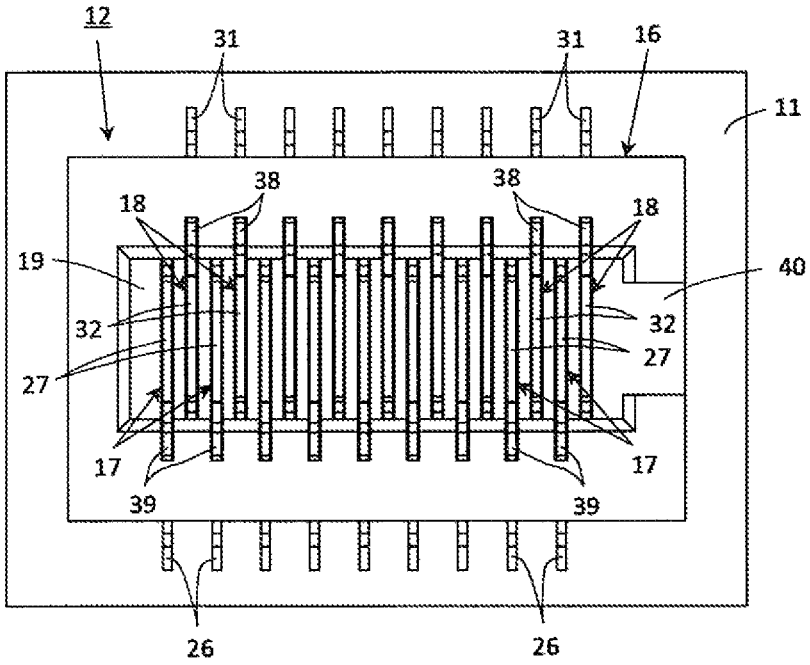

12
31
31
16
11
38
38
18
18
19
40
32
32
27
27
17
17
39
39
26
26

FIG. 3

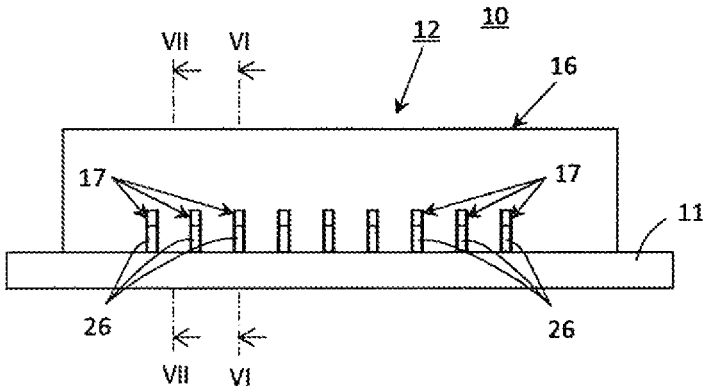

VII
VI
12
10
16
17
17
11
26
26
VII
VI

FIG. 4

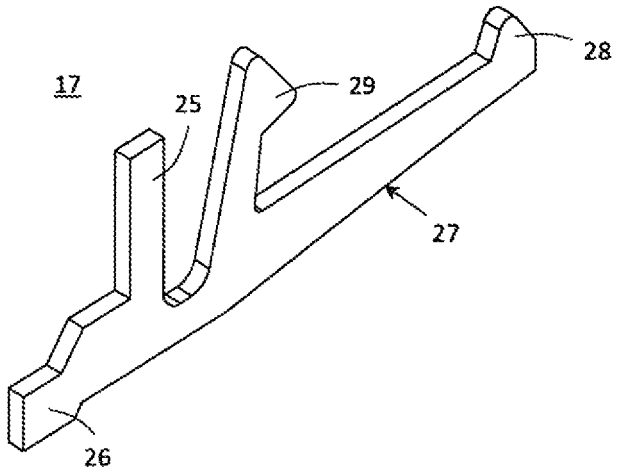


FIG. 5

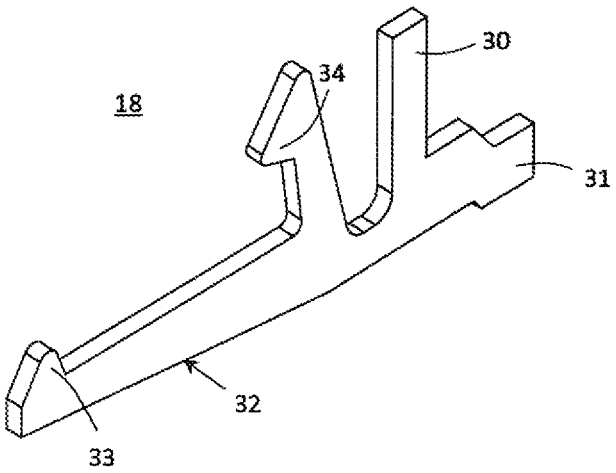


FIG. 6

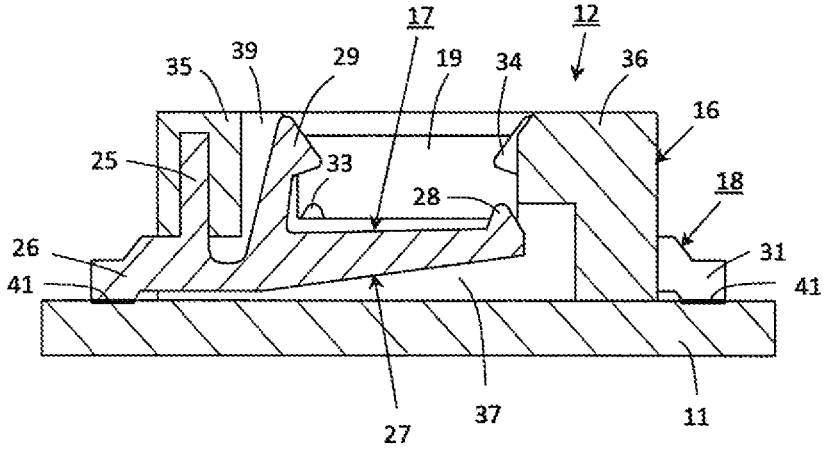

17
12
35
39
29
19
34
36
16
25
33
28
18
26
31
41
41
27
37
11

FIG. 7

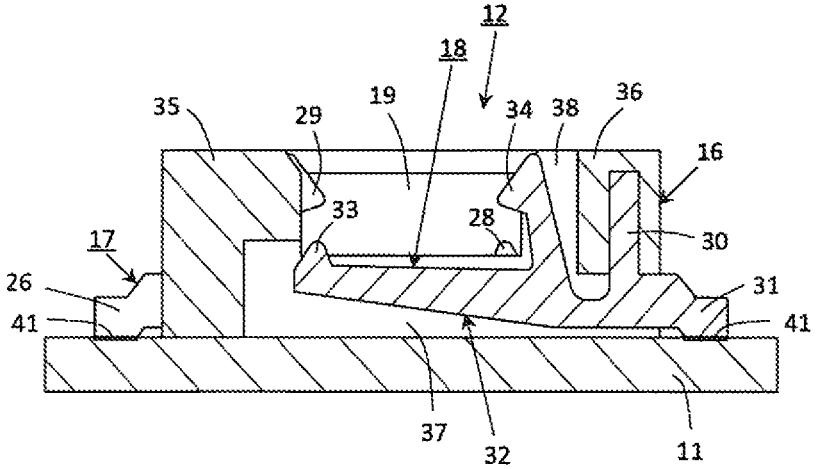

12
18
35
29
19
34
38
36
16
33
28
30
17
26
31
41
41
37
32
11

FIG. 8

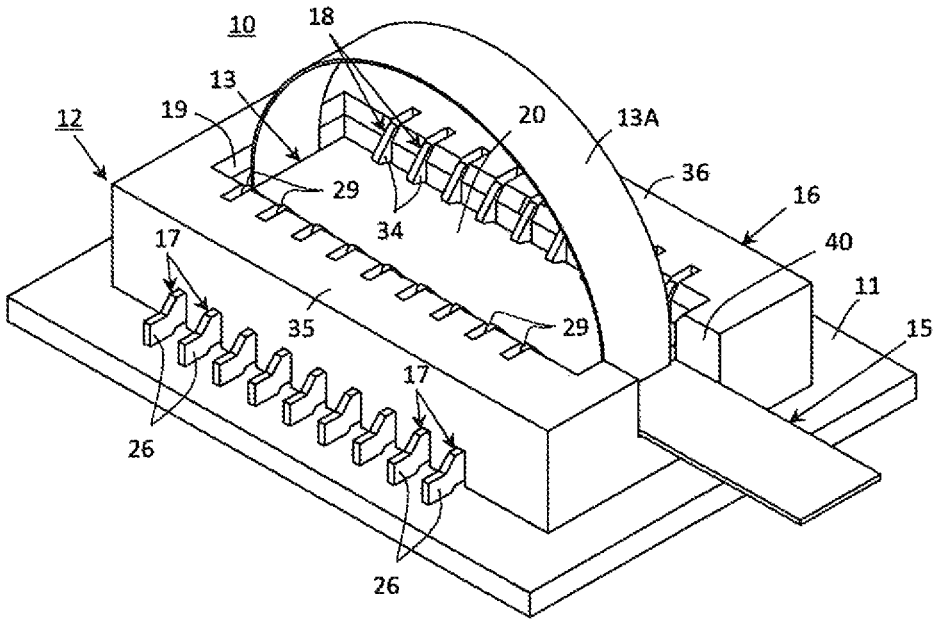

10
18
13
19
12
20
13A
36
16
29
34
40
17
11
35
29
15
17
26
26

FIG. 9

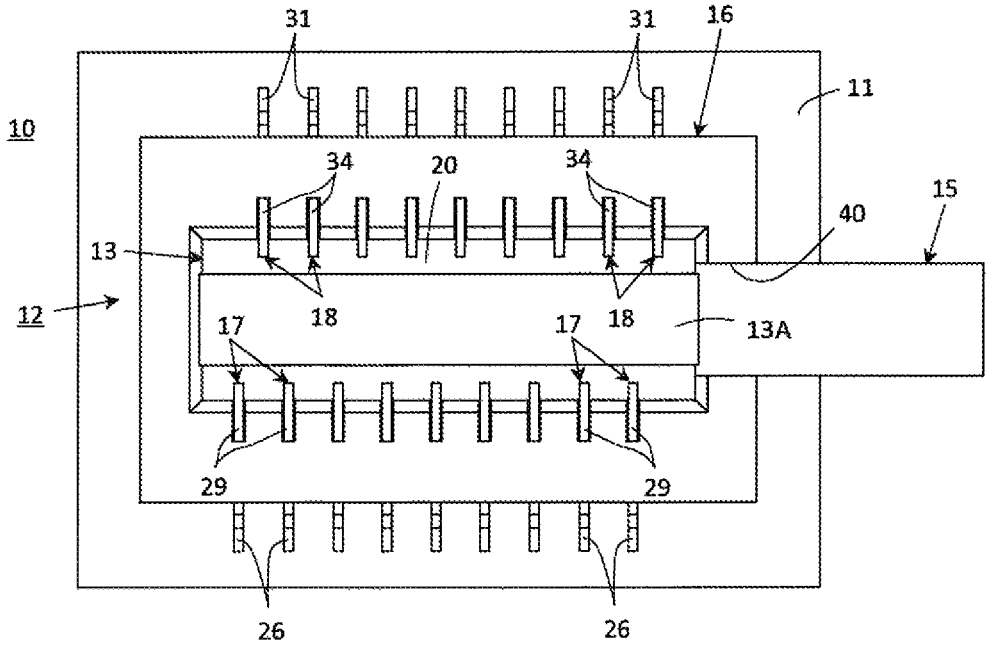

31
31
16
11
10
34
20
34
15
40
13
12
18
18
13A
17
17
29
29
26
26

FIG. 10

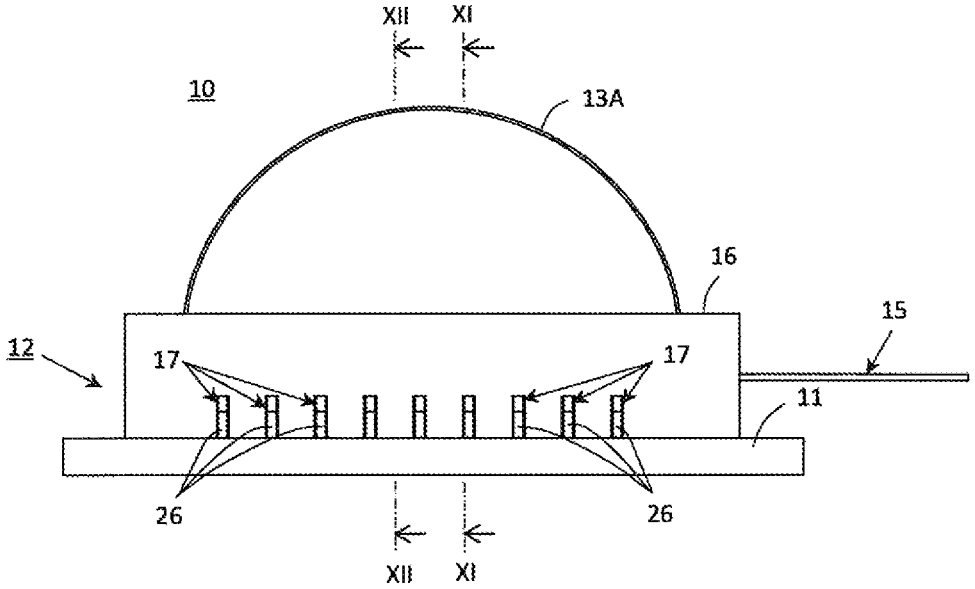

XII
XI
10
13A
16
15
12
17
17
11
26
26
XII
XI

FIG. 11

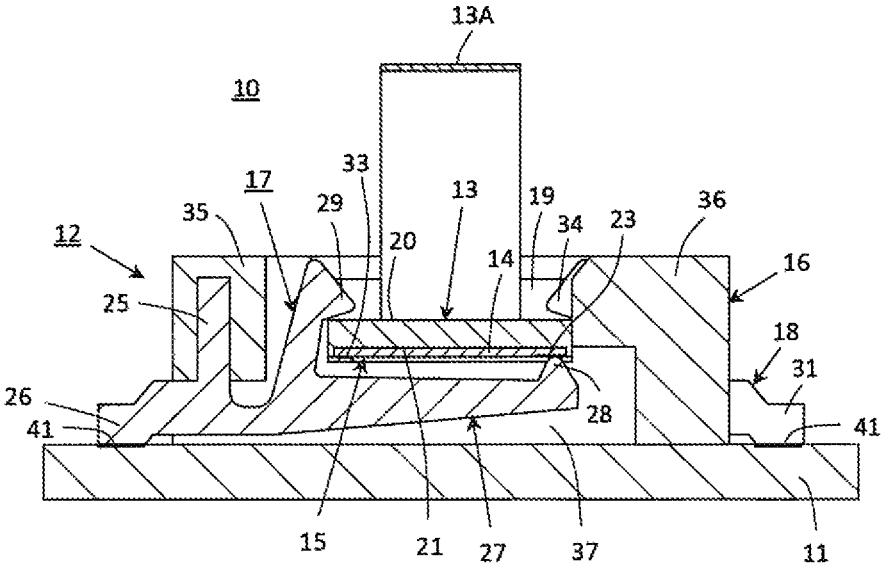

13A
10
17
33
13
19
36
35
29
34
23
12
20
14
16
25
18
31
26
28
41
41
15
21
27
37
11

FIG. 12

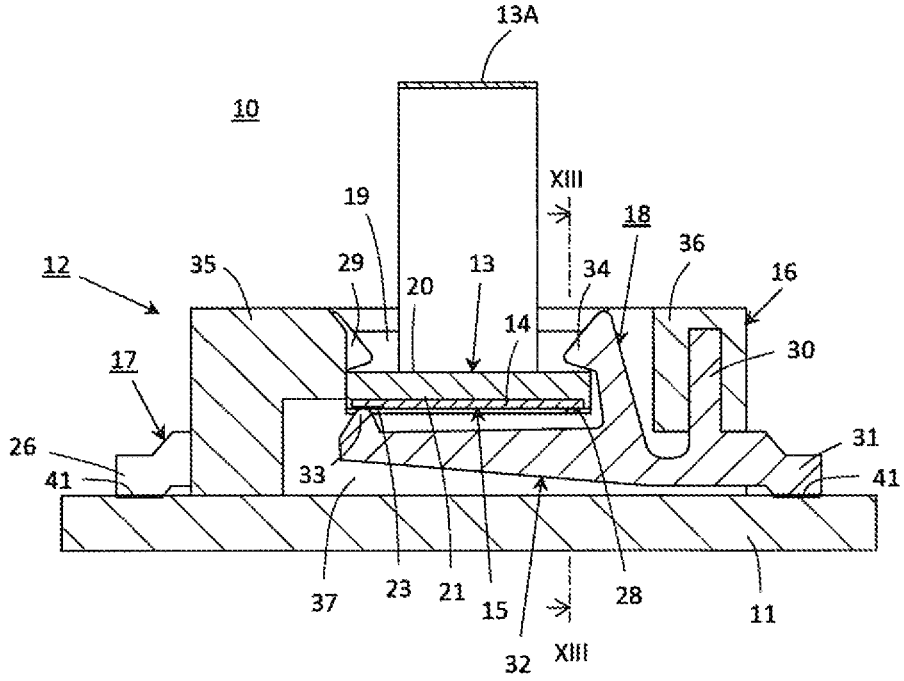
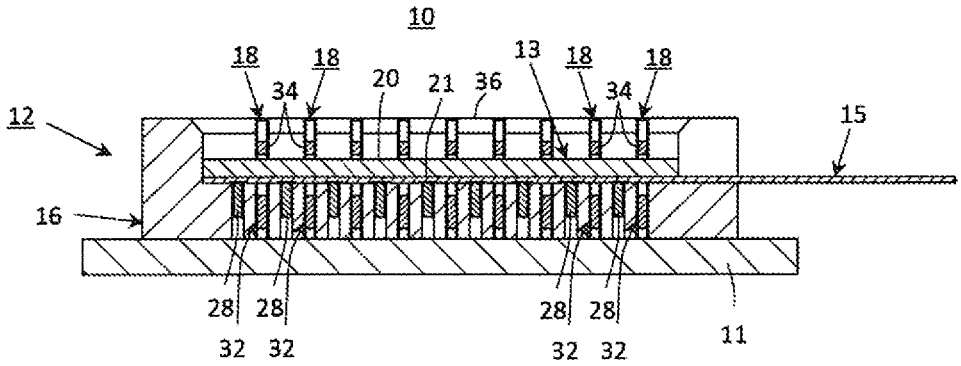

13A
10
XIII
19
18
36
12
35
29
20
13
34
16
14
30
17
31
26
33
41
41
37
23
21
15
28
11
32
XIII

FIG. 13


10
18
18
13
18
18
34
20
21
36
34
12
15
16
28
28
28
28
11
32
32
32
32

CIRCUIT-TERMINAL CONNECTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a circuit-terminal connecting device, and more particularly to an improvement in a circuit-terminal connecting device used for connecting first circuit-terminals provided on a mail circuit board with second circuit-terminals provided on a flat circuit member, such as a flexible printed circuit board (hereinafter, referred to as an FPC), which is mounted on the main circuit board to be electrically coupled with the main circuit board.

2. Description of the Prior Art Including Information Disclosed Under 37 CFR 1.97 and 37 CFR 1.98

There has been proposed, for the purpose of saving a space in an electronic apparatus, to lay a flat circuit member, such as a relatively small-sized FPC, on top of a main circuit board on which various electrical or electronic parts are mounted when the flat circuit member is electrically coupled with the main circuit board in the electronic apparatus. Such an electrical coupling between the main circuit board and the flat circuit member wherein the flat circuit member is laid on top of the main circuit board is hereinafter referred to as an electrical piled coupling.

There have been also previously proposed several means for connecting a plurality of circuit-terminals provided on a flat circuit member, such as an FPC, respectively with a plurality of another circuit-terminals provided on a main circuit board in a condition wherein the main circuit board and the flat circuit member are put in the electrical piled coupling. With one of such means previously proposed, there has been constituted a circuit-terminal connecting structure in which an electrical connector having an insulated housing is mounted on a main circuit board, a flat circuit member is provided with a reinforced portion attached to a reinforcing board, and the reinforced portion of the flat circuit member attached to the reinforcing board is directly engaged with the insulated housing of the electrical connector so that a plurality of circuit-terminals provided on the reinforced portion of the flat circuit member are connected respectively with a plurality of circuit-terminals provided on the main circuit board, as disclosed in, for example, the Japanese patent application published before examination under publication number HEI 6-68940 (hereinafter, referred to as a published prior art document 1).

In the circuit-terminal connecting structure disclosed in the published prior art document 1, an electrical connector (a connector (**3**)) having an insulated housing (an insulator (**30**)) provided to be fixed to a main circuit board (a printed circuit board) is mounted on the main circuit board and a flat circuit member (an FPC cable (**1**)) has a reinforced portion thereof which is reinforced with a reinforcing board member (**2**). The insulated housing (**30**) of the electrical connector (**3**) is provided with a board member holding portion on which a plurality of contacts (**33**) are arranged and by which the reinforced portion of the flat circuit member (**1**) is held. A pair of board member locking portions (locking members (**37**)) are provided to stand respectively at a pair of end portions of the board holding portion in a direction along which the contacts (**33**) are arranged (a contact-arrangement direction) so that the contacts (**33**) are arranged between the board member locking portions (**37**) opposite to each other. An engaging hole (**37***a*) is formed on each of the board member locking portions (**37**).

The reinforced portion of the flat circuit member (**1**) is provided with a plurality of circuit-terminal s arranged on a lower surface thereof and the reinforcing board member (**2**) attached to an upper surface thereof. The reinforced portion of the flat circuit member (**1**) with its lower surface on which the circuit-terminals are arranged is held, together with the reinforcing board member (**2**) attached thereto, by the board member holding portion of the insulated housing (**30**) of the electrical connector (**3**). The reinforcing board member (**2**) is provided with a pair of projections (engaging projections (**23**) formed respectively at a pair of end portions thereof in its longitudinal direction extending to be coincide with the contact-arrangement direction when the reinforcing board member (**2**) is held by the board member holding portion of the insulated housing (**30**).

When the reinforced portion of the flat circuit member (**1**) with the reinforcing board member (**2**) attached to the upper surface of the reinforced portion is held by the board member holding portion of the insulated housing (**30**) of the electrical connector (**3**), the contacts (**33**) arranged on the board member holding portion of the insulated housing (**30**) and soldered respectively to a plurality of circuit-terminal s of the main circuit board are caused to come into resilience-contact with the circuit-terminals arranged on the reinforced portion of the flat circuit member (**1**). Further, the projections (**23**) formed at the end portions of the reinforcing board member (**2**) attached to the reinforced portion of the flat circuit member (**1**) are put in engagement respectively with the engaging holes (**37***a*) formed on the board member locking portions (**37**) standing respectively at the end portions of the board holding portion. Thereby, the end portions in the longitudinal direction of the reinforcing board member (**2**) are locked respectively by the board member locking portions (**37**) so that it is expected that a condition wherein the contacts (**33**) arranged on the board member holding portion of the electrical connector (**3**) are put in resilience-contact with the circuit-terminals arranged on the reinforced portion of the flat circuit member (**1**) is stably maintained.

When the end portions in the longitudinal direction of the reinforcing board member (**2**) are locked respectively by the board member locking portions (**37**) as described above in the circuit-terminal connecting structure disclosed in the published prior art document 1, the reinforced portion of the flat circuit member (**1**) and the reinforcing board member (**2**) attached thereto are resiliently pushed up from the side of the lower surface of the reinforced portion of the flat circuit member (**1**) by the contacts (**33**) arranged on the board member holding portion of the insulated housing (**30**) of the electrical connector (**3**). Thereby, it is feared that the reinforced portion of the flat circuit member (**1**) and the reinforcing board member (**2**) attached thereto are compulsorily curved so that a middle portion between the end portions in the longitudinal direction of the reinforcing board member (**2**) protrudes to go away from the board member holding portion of the insulated housing (**30**). If the reinforced portion of the flat circuit member (**1**) and the reinforcing board member (**2**) attached thereto are practically subjected to a condition to be curved as mentioned above, for example, the circuit-terminals arranged on the reinforced portion of the flat circuit member (**1**) are adversely affected by the curve brought about on the reinforced portion of the flat circuit member (**1**) and the reinforcing board member (**2**) attached thereto.

Accordingly, there has been further previously proposed an improved circuit-terminal connecting structure which is able to avoid the disadvantages accompanied with the above-described circuit-terminal connecting structure disclosed in the published prior art document 1, as disclosed in, for example, the Japanese patent application published before examination

under publication number 2012-252912 (hereinafter, referred to as a published prior art document 2).

In the circuit-terminal connecting structure disclosed in the published prior art document 2, when a reinforced portion of a flat circuit member (a FPC cable (**301**)) is held, together with a reinforcing board member (a reinforcing board (**304**)), by a board member holding portion of an insulated housing (a housing (**102**)) of an electrical connector (a flat cable connector (**101**)) mounted on a main circuit board (a circuit board (**201**)), a pair of end portions in a longitudinal direction of the reinforcing board member (**304**) are locked respectively by a pair of board member locking portions (locking portions (**103**)) provided on the insulated housing (**102**). Under such a condition, a plurality of contacts (contacts (**105**)) arranged on the board member holding portion of the insulated housing (**102**) of the electrical connector (**101**) along the longitudinal direction of the reinforcing board member (**304**) and soldered respectively to a plurality of circuit-terminal s of the main circuit board (**201**) are caused to come into resilient-contact with a plurality of circuit-terminals (terminals (**302**A)) arranged on the reinforced portion of the flat circuit member (**301**). Thereby, the reinforced portion of the flat circuit member (**301**) and the reinforcing board member (**304**) attached thereto are resiliently pushed up from the side of a lower surface of the reinforced portion of the flat circuit member (**301**) by the contacts (**105**) arranged on the board member holding portion of the insulated housing (**102**) under the condition wherein the end portions in the longitudinal direction of the reinforcing board member (**304**) are locked respectively by the board member locking portions (**103**) provided on the insulated housing (**102**).

The reinforcing board member (**304**) attached to the reinforced portion of the flat circuit member (**301**) is provided, at one of side ends each extending in a longitudinal direction of the reinforcing board member (**304**), with a bent portion (an engaging projection (**304**E)) spreading over the side ends. The bent portion (**304**E) is operative to prevent the reinforcing board member (**304**) from being curved in the longitudinal direction of the reinforcing board member (**304**). As a result, even if the reinforced portion of the flat circuit member (**301**) and the reinforcing board member (**304**) attached thereto are resiliently pushed up from the side of the lower surface of the reinforced portion of the flat circuit member (**301**) by the contacts (**105**) arranged on the board member holding portion of the insulated housing (**102**) under the condition wherein the end portions in the longitudinal direction of the reinforcing board member (**304**) are locked respectively by the board member locking portions (**103**) provided on the insulated housing (**102**), the reinforced portion of the flat circuit member (**301**) and the reinforcing board member (**304**) attached thereto are prevented, by the bent portion (**304**E) provided at the side end of the reinforcing board member (**304**) to spread over the same, from being caused to curve in the longitudinal direction of the reinforcing board member (**304**) so that a middle portion between the end portions in the longitudinal direction of the reinforcing board member (**304**) is also prevented from protruding to go away from the board member holding portion of the insulated housing (**102**).

In the case of such a previously proposed circuit-terminal connecting structure used as disclosed in the published prior art document 2 in which the circuit-terminal s provided on the flat circuit member are caused to come into contact respectively with circuit-terminals provided on the main circuit board under the condition wherein the main circuit board and the flat circuit member are put in the electrical piled coupling, it is also desired to reduce as much as practicable a thickness of the electrical connector mounted on the main circuit board and therefore it is considered to make the insulated housing of the electrical connector relatively thin so that the electrical connector is subjected to reduction in thickness.

When the insulated housing of the electrical connector is made to be relatively thin so as to reduce the thickness of the electrical connector, the stiffness of the insulated housing is also reduced undesirably. Under a condition wherein the insulated housing of the electrical connector is made to be relatively thin, when the reinforcing board member attached to the reinforced portion of the flat circuit member is provided with the bent portion spreading over the side end extending in the longitudinal direction of the reinforcing board member and thereby the reinforced portion of the flat circuit member and the reinforcing board member attached thereto are prevented, by the bent portion provided at the side end of the reinforcing board member, from being caused to curve in the longitudinal direction of the reinforcing board member so that the middle portion between the end portions in the longitudinal direction of the reinforcing board member is also prevented from protruding to go away from the board member holding portion of the insulated housing even if the reinforced portion of the flat circuit member and the reinforcing board member attached thereto are resiliently pushed up from the side of the lower surface of the reinforced portion of the flat circuit member by the contacts arranged on the board member holding portion of the insulated housing under the condition wherein the end portions in the longitudinal direction of the reinforcing board member are locked respectively by the board member locking portions provided on the insulated housing, a resilient press-force caused to act on the reinforced portion of the flat circuit member and the reinforcing board member attached thereto by the contacts arranged on the board member holding portion of the insulated housing brings about a reactive force acting on the insulated housing. With such a reactive force thus brought about, it is feared that the insulated housing with its stiffness undesirably reduced is compulsorily curved so that a middle portion between a pair of end portions of the insulating housing opposite to each other in a longitudinal direction of the insulating housing along which the contacts are arranged protrudes to go away from the flat circuit member and the reinforcing board member attached thereto.

In the case where the insulated housing with its stiffness undesirably reduced is compulsorily curved in such a manner as mentioned above, an undesirable stress is inflicted on soldering portions on the main circuit board at which the contacts arranged on the insulated housing are soldered respectively to the circuit-terminals provided on the main circuit board and thereby it is feared that undesirable cracks are brought about on the soldering portions.

BRIEF SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a circuit-terminal connecting device which comprises an electrical connector having an insulated housing mounted on a main circuit board on which a plurality of first circuit-terminals are provided and a plurality of resilient contacts arranged on the insulated housing and is used for causing the resilient contacts to come into contact respectively with a plurality of second circuit-terminals provided on a flat circuit member, such as an FPC, so as to connect electrically the second circuit-terminals provided on the flat circuit member with the first circuit-terminal s provided on the main circuit board, and which avoids the aforementioned problems and disadvantages encountered with the prior art.

Another object of the present invention is to provide a circuit-terminal connecting device which comprises an electrical connector having an insulated housing mounted on a main circuit board on which a plurality of first circuit-terminals are provided and a plurality of resilient contacts arranged on the insulated housing and is used for causing the resilient contacts to come into contact respectively with a plurality of second circuit-terminals provided on a flat circuit member, such as an FPC, so as to connect electrically the second circuit-terminals provided on the flat circuit member with the first circuit-terminals provided on the main circuit board, and with which the insulated housing of the electrical connector can be prevented from being caused to curve with a reactive force brought about to act on the insulated housing by a resilient press-force caused to act on the flat circuit member by the resilient contacts even if the insulated housing is made to be relatively thin so as to reduce the thickness of the electrical connector and thereby the stiffness of the insulated housing is also reduced undesirably.

According to the present invention, there is provided a circuit-terminal connecting device which comprises an electrical connector having an insulated housing mounted on a main circuit board and a plurality of resilient contacts arranged on the insulated housing, each of which has a board connecting portion provided to be connected respectively to a plurality of first circuit-terminals provided on the main circuit board, and a flat circuit member having a reinforced portion attached to one of first and second surface portions opposite to each other of a reinforcing board member which is operative to engage with the insulated housing of the electrical connector and provided thereon a plurality of second circuit-terminals. The resilient contacts include first and second contacts arranged one after the other, and each of the first and second contacts has, in addition to the board connecting portion, a fixable portion provided to be fixed to the insulated housing and a resilient arm portion extending from the fixable portion to get under the board member accommodating portion provided on the insulated housing. The resilient arm portion of each of the first and second contacts is provided with a contact point for coming into press-contact with the second circuit-terminal provided on the reinforced portion of the flat circuit member so as to cause the second circuit-terminals to be electrically connected respectively with the first circuit-terminals provided on the main circuit board through the first and second contacts and a locking portion for engaging with the other of the first and second surface portions of the reinforcing board member to lock the reinforcing board member. The insulated housing of the electrical connector is provided thereon with a board member accommodating portion for accommodating the reinforcing board member accompanied with the reinforced portion of the flat circuit member. A first portion of the insulated housing to which the fixable portion of each of the first contacts is fixed and a second portion of the insulated housing to which the fixable portion of each of the second contacts is fixed are provided to be opposite to each other with the board member accommodating portion of the insulated housing provided between the first and second portions. The contact point provided on the resilient arm portion extending from the fixable portion of each of the first contacts and the locking portion provided on the resilient arm portion extending from the fixable portion of each of the second contacts are placed on the side of the second portion of the insulated housing, and the contact point provided on the resilient arm portion extending from the fixable portion of each of the second contacts and the locking portion provided on the resilient arm portion extending from the fixable portion of each of the first contacts are placed on the side of the first portion of the insulated housing.

In the circuit-terminal connecting device thus constituted in accordance with the present invention, when the reinforcing board member having the first and second surfaces opposite to each other, to one of which the reinforced portion of the flat circuit member is attached, is accommodated, together with the reinforced portion of the flat circuit member, in the board member accommodating portion of the insulated housing of the electrical connector, each of the first contacts arranged on the insulated housing causes the contact point provided on the resilient arm portion thereof to come into contact with the second circuit-terminal provided on the reinforced portion of the flat circuit member attached to the reinforcing board member which is accommodated in the board member accommodating portion of the insulated housing on the side of the second portion of the insulated housing to which the fixable portion of each of the second contacts is fixed and further causes the locking portion provided on the resilient arm portion thereof to engage with the other of the first and second surface portions of the reinforcing board member for locking the reinforcing board member in the board member accommodating portion of the insulated housing on the side of the first portion of the insulated housing to which the fixable portion of each of the first contacts is fixed, and each of the second contacts arranged on the insulated housing causes the contact point provided on the resilient arm portion thereof to come into contact with the second circuit-terminal provided on the reinforced portion of the flat circuit member attached to the reinforcing board member which is accommodated in the board member accommodating portion of the insulated housing on the side of the first portion of the insulated housing and further causes the locking portion provided on the resilient arm portion thereof to engage with the other of the first and second surface portions of the reinforcing board member for locking the reinforcing board member in the board member accommodating portion of the insulated housing on the side of the second portion of the insulated housing.

In such a manner as mentioned above, the contact point provided on the resilient arm portion of each of the first and second contacts which are arranged one after the other with the board connecting portions connected respectively with the first circuit-terminals provided on the main circuit board, is caused to come into contact with the second circuit-terminal provided on the flat circuit member and thereby the second circuit-terminals provided on the flat circuit member are electrically connected respectively with the first circuit-terminals provided on the main circuit board through the resilient contacts provided in the electrical connector. In that case, the contact point provided on the resilient arm portion of each of the first contacts is operative to inflict a resilient press-force upon the reinforced portion of the flat circuit member attached to the reinforcing board member through the second circuit-terminal provided thereon to push the same toward one of the first and second surface portions of the reinforcing board member on the side of the second portion of the insulated housing and the locking portion provided on the resilient arm portion of each of the first contacts is operative to engage with the other of the first and second surface portions of the reinforcing board member for locking the reinforcing board member on the side of the first portion of the insulated housing. Further, the contact point provided on the resilient arm portion of each of the second contacts is operative to inflict a resilient press-force upon the reinforced portion of the flat circuit member attached to the reinforcing board member through the second circuit-terminal provided thereon to push

the same toward one of the first and second surface portions of the reinforcing board member on the side of the first portion of the insulated housing and the locking portion provided on the resilient arm portion of each of the second contacts is operative to engage with the other of the first and second surface portions of the reinforcing board member for locking the reinforcing board member on the side of the second portion of the insulated housing.

Consequently, under the condition wherein the first and second portions of the insulated housing are opposite to each other with the board member accommodating portion of the insulated housing provided between the first and second portions, on the side of the second portion of the insulated housing, the resilient press-force inflicted upon the flat circuit member by the contact point of each of the first contacts is received through the reinforced portion of the flat circuit member and the reinforcing board member by the locking portion of each of the second contact, and on the side of the first portion of the insulated housing, the resilient press-force inflicted upon the flat circuit member by the contact point of each of the second contacts is received through the reinforced portion of the flat circuit member and the reinforcing board member by the locking portion of each of the first contact.

With the circuit-terminal connecting device according to the present invention, when the reinforcing board member to which the reinforced portion of the flat circuit member is attached is accommodated in the board member accommodating portion of the insulated housing, since the resilient press-force inflicted upon the flat circuit member by the contact point of each of the first contacts is received by the locking portion of each of the second contacts and the resilient press-force inflicted upon the flat circuit member by the contact point of each of the second contacts is received by the locking portion of each of the first contacts in such a manner as described above, the insulated housing of the electrical connector can be prevented from being caused to curve with a reactive force brought about to act on the insulated housing by the resilient press-force caused to act on the flat circuit member by the first and second contacts constituting the resilient contacts even if the insulated housing is made to be relatively thin so as to reduce the thickness of the electrical connector and thereby the stiffness of the insulated housing is also reduced undesirably. As a result, the circuit-terminal connecting device according to the present invention is able to avoid such a disadvantage that an undesirable stress is inflicted on soldering portions on the main circuit board at which the first and second contacts arranged on the insulated housing of the electrical connector are soldered respectively to the circuit-terminals provided on the main circuit board so that undesirable cracks are brought about on the soldering portions.

The above, and other objects, features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a schematic perspective view showing an embodiment of circuit-terminal connecting device which comprises an electrical connector having an insulated housing mounted on a main circuit board and a flat circuit member having a reinforced portion thereof attached to a reinforcing board member;

FIG. **2** is a schematic plan view showing the electrical connector shown in FIG. **1** which has the insulated housing mounted on the main circuit board;

FIG. **3** is a schematic side view showing the electrical connector shown in FIG. **1** which has the insulated housing mounted on the main circuit board;

FIG. **4** is a schematic perspective view showing a first contact provided in the electrical connector shown in FIG. **1**;

FIG. **5** is a schematic perspective view showing a second contact provided in the electrical connector shown in FIG. **1**;

FIG. **6** is a schematic cross-sectional view taken along line VI-VI in FIG. **3**;

FIG. **7** is a schematic cross-sectional view taken along line VII-VII in FIG. **3**;

FIG. **8** is a schematic perspective view showing the electrical connector shown in FIG. **1** and the reinforcing board member to which the reinforced portion of the flat circuit member is attached as shown in FIG. **1** and which is put in engagement with the electrical connector;

FIG. **9** is a schematic plan view showing the electrical connector shown in FIG. **1** and the reinforcing board member to which the reinforced portion of the flat circuit member is attached as shown in FIG. **1** and which is put in engagement with the electrical connector;

FIG. **10** is a schematic side view showing the electrical connector shown in FIG. **1** and the reinforcing board member to which the reinforced portion of the flat circuit member is attached as shown in FIG. **1** and which is put in engagement with the electrical connector;

FIG. **11** is a schematic cross-sectional view taken along line XI-XI in FIG. **10**;

FIG. **12** is a schematic cross-sectional view taken along line XII-XII in FIG. **10**; and

FIG. **13** is a schematic cross-sectional view taken along line XIII-XIII in FIG. **12**.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows an electrical connector and a flat circuit member which are main structural components of an embodiment of circuit-terminal connecting device according to the present invention.

Referring to FIG. **1**, a circuit-terminal connecting device **10**, which constitutes the embodiment of circuit-terminal connecting device according to the present invention, comprises an electrical connector **12** provided on a main circuit board **11** and a flat circuit member **15**, such as an FPC shaped into a strip, having a reinforced portion **14** thereof (shown in FIGS. **11** and **12** explained later) attached to a reinforcing board member **13** configured to be rectangular for engaging with the electrical connector **12**. The electrical connector **12** has an insulated housing **16** mounted on the main circuit board **11** and a plurality of resilient contacts including first contacts **17** and second contacts **18** arranged one after the other on the insulated housing **16**, as shown also in FIGS. **2** and **3** in each of which the electrical connector **12** is shown. The insulated housing **16** is provided with a board member accommodating portion **19** shaped into a rectangular hole for accommodating the reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15**. The board member accommodating portion **19** has an opening portion opened into a direction perpendicular to a surface of the main circuit board **11** on which the insulated housing **16** is fixed.

The reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15** has first and second surface portions **20** and **21** opposite to each other

and the reinforced portion **14** of the flat circuit member **15** is attached to the second surface portion **21** of the reinforcing board member **13** so as to be buried in the second surface portion **21**. A plurality of circuit-terminals **23** (shown in FIGS. **11** and **12** explained later) are provided on a surface of the reinforced portion **14** of the flat circuit member **15**, which is operative to face a bottom of the board member accommodating portion **19** when the reinforced portion **14** of the flat circuit member **15** is accommodated in the board member accommodating portion **19**.

The reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15** is accommodated in the board member accommodating portion **19** through the opening portion of the same so as to cause the reinforced portion **14** of the flat circuit member **15** to be opposite to the bottom of the board member accommodating portion **19**. A tape-handle **13**A is attached to the reinforcing board member **13** to be used for pulling the reinforcing board member **13** accommodated in the board member accommodating portion **19** out of the board member accommodating portion **19**.

As shown in FIG. **4**, each of the first contacts **17** is made of resilient metallic plate subjected to punching and bending process to have a fixable portion **25** provided to be fixed to the insulated housing **16**, a board connecting portion **26** extending from the fixable portion **25** to be connected to a circuit-terminal **41** (shown in FIGS. **6**, **7**, **11** and **12** explained later) provided on the main circuit board **11** and a resilient arm portion **27** extending from the fixable portion **25** in a direction opposite to the board connecting portion **26**. The resilient arm portion **27** is provided at its top end portion with a contact point **28** for coming into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and further provided in the vicinity of the fixable portion **25** with a locking portion **29** for engaging with the first surface portion **20** of the reinforcing board member **13** to lock the reinforcing board member **13**.

Similarly, as shown in FIG. **5**, each of the second contacts **18** is made of resilient metallic plate subjected to punching and bending process to have a fixable portion **30** provided to be fixed to the insulated housing **16**, a board connecting portion **31** extending from the fixable portion **30** to be connected with the circuit-terminal **41** on the main circuit board **11** and a resilient arm portion **32** extending from the fixable portion **30** in a direction opposite to the board connecting portion **31**. The resilient arm portion **32** is provided at its top end portion with a contact point **33** for coming into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and further provided in the vicinity of the fixable portion **30** with a locking portion **34** for engaging with the first surface portion **20** of the reinforcing board member **13** to lock the reinforcing board member **13**.

The insulated housing **16** has a pair of portions **35** and **36** each elongating in a direction along which the first and second contacts **17** and **18** are arranged one after the other to be opposite to each other with the board member accommodating portion **19** between the portions **35** and **36**. The fixable portion **25** of each of the first contacts **17** is fixed to the portion **35** of the insulated housing **16** and the resilient arm portion **27** of each of the first contacts **17** extends from the fixable portion **25** fixed to the portion **35** of the insulated housing **16** toward the portion **36** of the insulated housing **16** to get under the board member accommodating portion **19** and the fixable portion **30** of each of the second contacts **18** is fixed to the portion **36** of the insulated housing **16** and the resilient arm portion **32** of each of the second contacts **18** extends from the fixable portion **30** fixed to the portion **36** of the insulated housing **16** toward the portion **35** of the insulated housing **16** to get under the board member accommodating portion **19**. Accordingly, the resilient arm portion **27** extending from the fixable portion **25** of each of the first contacts **17** and the resilient arm portion **32** extending from the fixable portion **30** of each of the second contacts **18** elongate respectively in directions opposite to each other.

The resilient arm portion **27** of each of the first contacts **17** is put in one of slits **37** formed to be arranged on the bottom of the board member accommodating portion **19** provided on the insulated housing **16** so as to cause the contact point **28** provided thereon to enter into the board member accommodating portion **19** and the resilient arm portion **32** of each of the second contacts **18** is put in another of the slits **37** so as to cause the contact point **33** provided thereon to enter into the board member accommodating portion **19**. The locking portion **29** provided on the resilient arm portion **27** of each of the first contacts **17** is put in one of slits **39** formed to be arranged on the portion **35** of the insulated housing **16** and the locking portion **34** provided on the resilient arm portion **32** of the second contact **18** is put in one of slits **38** formed to be arranged on the portion **36** of the insulated housing **16**.

As shown in FIG. **6** showing a cross-section taken along line VI-VI in FIG. **3**, in the board member accommodating portion **19** provided on the insulated housing **16**, the contact point **28** provided on the resilient arm portion **27** of each of the first contacts **17** is positioned in the vicinity of the portion **36** of the insulated housing **16** to which the fixable portion **30** of each of the second contacts **18** is fixed and the locking portion **29** provided on the resilient arm portion **27** of each of the first contacts **17** is positioned in the vicinity of the portion **35** of the insulated housing **16** to which the fixable portion **25** of each of the first contacts **17** is fixed. Further, as shown in FIG. **7** showing a cross-section taken along line VII-VII in FIG. **3**, in the board member accommodating portion **19** provided on the insulated housing **16**, the contact point **33** provided on the resilient arm portion **32** of each of the second contacts **18** is positioned in the vicinity of the portion **35** of the insulated housing **16** to which the fixable portion **25** of each of the first contacts **17** is fixed and the locking portion **34** provided on the resilient arm portion **32** of each of the second contacts **18** is positioned in the vicinity of the portion **36** of the insulated housing **16** to which the fixable portion **30** of each of the second contacts **18** is fixed.

When the flat circuit member **15** having the reinforced portion **14** thereof attached to the reinforcing board member **13** is put in engagement with the electrical connector **12** having the insulated housing **16** mounted on the main circuit board **11**, the reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15** is accommodated in the board member accommodating portion **19** provided on the insulated housing **16** of the electrical connector **12** through the opening portion of the same so as to cause the reinforced portion **14** of the flat circuit member **15** to be opposite to the bottom of the board member accommodating portion **19**. Thereby, the electrical connector **12** provided on the main circuit board **11** and the flat circuit member **15** having the reinforced portion **14** thereof attached to the reinforcing board member **13** are put in a condition shown in each of FIGS. **8** (a perspective view), **9** (a plan view) and **10** (a side view).

As shown in each of FIGS. **8** to **10**, when the flat circuit member **15** is accommodated in the board member accommodating portion **19** provided on the insulated housing **16**, a portion of the flat circuit member **15** having the reinforced portion **14** thereof attached to the reinforcing board member **13** projects to the outside of the insulated housing **16** through

a cutout **40** formed on the insulated housing **16**. The tape-handle **13**A attached to the reinforcing board member **13** is positioned on the insulated housing **16** to project above.

Under a condition wherein the reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15** is accommodated in the board member accommodating portion **19** provided on the insulated housing **16** of the electrical connector **12** in such a manner as mentioned above, as shown in FIG. **11** showing a cross-section taken along line XI-XI in FIG. **10**, each of the first contacts **17** arranged on the insulated housing **16** with the board connecting portion **26** connected to the circuit-terminal **41** on the main circuit board **11** is operative to cause the contact point **28** provided on the resilient arm portion **27** and positioned in the vicinity of the portion **36** of the insulated housing **16** to come into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and further to cause the locking portion **29** provided on the resilient arm portion **27** and positioned in the vicinity of the portion **35** of the insulated housing **16** to engage with the first surface portion **20** of the reinforcing board member **13** for locking the reinforcing board member **13** in the board member accommodating portion **19** provided on the insulated housing **16**.

Similarly, as shown in FIG. **12** showing a cross-section taken along line XII-XII in FIG. **10**, each of the second contacts **18** arranged on the insulated housing **16** with the board connecting portion **31** thereof connected to the circuit-terminal **41** on the main circuit board **11** is operative to cause the contact point **33** provided on the resilient arm portion **32** and positioned in the vicinity of the portion **35** of the insulated housing **16** to come into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and further to cause the locking portion **34** provided on the resilient arm portion **32** and positioned in the vicinity of the portion **36** of the insulated housing **16** to engage with the first surface portion **20** of the reinforcing board member **13** for locking the reinforcing board member **13** in the board member accommodating portion **19** provided on the insulated housing **16**.

With the contact point **28** provided on the resilient arm portion **27** of each of the first contacts **17** each having the board connecting portion **26** connected to the circuit-terminal **41** on the main circuit board **11** so as to be caused to come into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and the contact point **33** provided on the resilient arm portion **32** of each of the second contacts **18** each having the board connecting portion **31** connected to the circuit-terminal **41** on the main circuit board **11** so as to be caused to come into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15**, the circuit-terminals **23** on the reinforced portion **14** of the flat circuit member **15** are electrically connected to the circuit-terminals **41** on the main circuit board **11** through the first contacts **17** and the second contacts **18**.

In that case, the contact point **28** provided on the resilient arm portion **27** of each of the first contacts **17** is operative to inflict a resilient press-force upon the reinforced portion **14** of the flat circuit member **15** attached to the reinforcing board member **13** through the circuit-terminal **23** provided on the reinforced portion **14** of the flat circuit member **15** to push the reinforced portion **14** of the flat circuit member **15** toward the first surface portion **20** of the reinforcing board member **13** on the side of the portion **36** of the insulated housing **16** and the locking portion **29** provided on the resilient arm portion **27** of each of the first contacts **17** is operative to engage with the first surface portion **20** of the reinforcing board member **13** for locking the reinforcing board member **13** on the side of the portion **35** of the insulated housing **16**. Further, the contact point **33** provided on the resilient arm portion **32** of each of the second contacts **18** is operative to inflict a resilient press-force upon the reinforced portion **14** of the flat circuit member **15** attached to the reinforcing board member **13** through the circuit-terminal **23** provided on the reinforced portion **14** of the flat circuit member **15** to push the reinforced portion **14** of the flat circuit member **15** toward the first surface portion **20** of the reinforcing board member **13** on the side of the portion **35** of the insulated housing **16** and the locking portion **34** provided on the resilient arm portion **32** of each of the second contacts **18** is operative to engage with the first surface portion **20** of the reinforcing board member **13** for locking the reinforcing board member **13** on the side of the portion **36** of the insulated housing **16**.

Consequently, as shown in FIG. **13** showing a cross-section taken along line XIII-XIII in FIG. **12**, under the condition wherein the portions **35** and **36** of the insulated housing **16** are opposite to each other with the board member accommodating portion **19** of the insulated housing **16** provided between the portions **35** and **36**, on the side of the portion **36** of the insulated housing **16**, the resilient press-force inflicted upon the flat circuit member **15** by the contact point **28** of each of the first contacts **17** is received through the reinforced portion **14** of the flat circuit member **15** and the reinforcing board member **13** by the locking portion **34** of each of the second contacts **18**, and on the side of the portion **35** of the insulated housing **16**, the resilient press-force inflicted upon the flat circuit member **15** by the contact point **33** of each of the second contacts **18** is received through the reinforced portion **14** of the flat circuit member **15** and the reinforcing board member **13** by the locking portion **29** of each of the first contacts **17**.

Further, since the first contacts **17** and the second contacts **18** are arranged one after the other on the insulated housing **16** of the electrical connector **12**, a first linear arrangement of contact-portions, at each of which the contact point **28** provided on the first contact **17** comes into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15**, and a second linear arrangement of contact-portions, at each of which the contact point **33** provided on the second contact **18** comes into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15**, are formed to be parallel with each other. The first linear arrangement of contact-portions is made in the vicinity of the portion **36** of the insulated housing **16** to which the fixable portion **30** of each of the second contacts **18** is fixed and the second linear arrangement of contact-portions is made in the vicinity of the portion **35** of the insulated housing **16** to which the fixable portion **25** of each of the first contacts **17** is fixed.

Similarly, a third linear arrangement of engagement-portions, at each of which the locking portion **29** provided on the first contact **17** engages with the first surface portion **20** of the reinforcing board member **13** to lock the reinforcing board member **13**, and a fourth linear arrangement of engagement-portions, at each of which the locking portion **34** provided on the second contact **18** engages with the first surface portion **20** of the reinforcing board member **13** to lock the reinforcing board member **13**, are formed to be parallel with each other. The third linear arrangement of engagement-portions is made in the vicinity of the portion **35** of the insulated housing **16** to which the fixable portion **25** of each of the first contacts **17** is fixed and the second linear arrangement of engagement-portions is made in the vicinity of the portion **36** of the insulated housing **16** to which the fixable portion **30** of each of the second contacts **18** is fixed.

In the circuit-terminal connecting device **10** thus constituted in accordance with the present invention, when the reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15** is accommodated in the board member accommodating portion **19** provided on the insulated housing **16** of the electrical connector **12**, the contact point **28** provided on the resilient arm portion **27** of each of the first contacts **17** arranged on the insulated housing **16** of the electrical connector **12** comes into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and the contact point **33** provided on the resilient arm portion **32** of each of the second contacts **18** arranged also on the insulated housing **16** comes into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15**, so that the circuit-terminals **23** on the reinforced portion **14** of the flat circuit member **15** are electrically connected to the circuit-terminals **41** on the main circuit board **11** through the first contacts **17** and the second contacts **18**.

In that case, under the condition wherein the portions **35** and **36** of the insulated housing **16** are opposite to each other with the board member accommodating portion **19** of the insulated housing **16** provided between the portions **35** and **36**, on the side of the portion **36** of the insulated housing **16**, the resilient press-force inflicted upon the flat circuit member **15** by the contact point **28** of each of the first contacts **17** is received through the reinforced portion **14** of the flat circuit member **15** and the reinforcing board member **13** by the locking portion **34** of each of the second contacts **18**, and on the side of the portion **35** of the insulated housing **16**, the resilient press-force inflicted upon the flat circuit member **15** by the contact point **33** of each of the second contacts **18** is received through the reinforced portion **14** of the flat circuit member **15** and the reinforcing board member **13** by the locking portion **29** of each of the first contacts **17**.

Consequently, with the circuit-terminal connecting device **10**, since the resilient press-force inflicted upon the flat circuit member **15** by the contact point **28** of each of the first contacts **17** is received by the locking portion **34** of each of the second contacts **18** and the resilient press-force inflicted upon the flat circuit member **15** by the contact point **33** of each of the second contacts **18** is received by the locking portion **29** of each of the first contacts **17** when the reinforcing board member **13** to which the reinforced portion **14** of the flat circuit member **15** is attached is accommodated in the board member accommodating portion **19** provided on the insulated housing **16** of the electrical connector **12**, the insulated housing **16** of the electrical connector **12** can be prevented from being caused to curve with a reactive force brought about to act on the insulated housing **16** by the resilient press-force caused to act on the flat circuit member **15** by the first and second contacts **17** and **18** constituting the resilient contacts even if the insulated housing **16** is made to be relatively thin so as to reduce the thickness of the electrical connector **12** and thereby the stiffness of the insulated housing **16** is also reduced undesirably. As a result, the circuit-terminal connecting device **10** is able to avoid such a disadvantage that an undesirable stress is inflicted on soldering portions on the main circuit board **11** at which the first and second contacts **17** and **18** arranged on the insulated housing **16** of the electrical connector **12** are soldered respectively to the circuit-terminals **41** on the main circuit board **11** so that undesirable cracks are brought about on the soldering portions.

Further, in the circuit-terminal connecting device **10**, the first contacts **17** and the second contacts **18** are arranged one after the other on the insulated housing **16** of the electrical connector **12**, so that the first linear arrangement of contact-portions, at each of which the contact point **28** provided on the first contact **17** comes into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15** and the second linear arrangement of contact-portions, at each of which the contact point **33** provided on the second contact **18** comes into press-contact with the circuit-terminal **23** on the reinforced portion **14** of the flat circuit member **15**, are formed to be parallel with each other. The first linear arrangement of contact-portions is made in the vicinity of the portion **36** of the insulated housing **16** to which the fixable portion **30** of each of the second contacts **18** is fixed and the second linear arrangement of contact-portions is made in the vicinity of the portion **35** of the insulated housing **16** to which the fixable portion **25** of each of the first contacts **17** is fixed. Consequently, the resilient press-force inflicted upon the flat circuit member **15** by the contact point **28** of each of the first contacts **17** and the resilient press-force inflicted upon the flat circuit member **15** by the contact point **33** of each of the second contacts **18** are well balanced to be dispersed within the reinforcing board member **13** accommodated, together with the reinforced portion **14** of the flat circuit member **15**, in the board member accommodating portion **19** provided on the insulated housing **16** of the electrical connector **12**, so that the reinforcing board member **13** is prevented from receiving an undesirable deflected press-force.

Incidentally, when the reinforcing board member **13** accompanied with the reinforced portion **14** of the flat circuit member **15** and accommodated in the board member accommodating portion **19** provided on the insulated housing **16** of the electrical connector **12** is required to get out of the board member accommodating portion **19**, the tape-handle **13A** attached to the flat circuit member **15** is pulled up to leave from the insulated housing **16**, so that the flat circuit member **15** is drawn out of the board member accommodating portion **19**.

The invention claimed is:

1. A circuit-terminal connecting device comprising;

an electrical connector having an insulated housing mounted on a main circuit board and a plurality of resilient contacts arranged on the insulated housing, each of said resilient contacts having a board connecting portion provided to be connected respectively to a plurality of first circuit-terminals provided on the main circuit board, and

a flat circuit member having a reinforced portion attached to one of first and second surface portions opposite to each other of a reinforcing board member, said reinforcing board member being operative to engage with the insulated housing of the electrical connector and provided thereon a plurality of second circuit-terminals,

wherein the resilient contacts include first and second contacts arranged one after the other and each of the first and second contacts has, in addition to the board connecting portion, a fixable portion provided to be fixed to the insulated housing and a resilient arm portion extending from the fixable portion to get under a board member accommodating portion provided on the insulated housing,

wherein the resilient arm portion of each of the first and second contacts is provided with a contact point for coming into press-contact with the second circuit-terminal provided on the reinforced portion of the flat circuit member so as to cause the second circuit-terminals to be electrically connected respectively with the first circuit-terminals provided on the main circuit board through the first and second contacts and a locking portion for

engaging with the other of the first and second surface portions of the reinforcing board member to lock the reinforcing board member,

wherein the insulated housing of the electrical connector is provided thereon with the board member accommodating portion for accommodating the reinforcing board member accompanied with the reinforced portion of the flat circuit member,

wherein a first portion of the insulated housing to which the fixable portion of each of the first contacts is fixed and a second portion of the insulated housing to which the fixable portion of each of the second contacts is fixed are provided to be opposite to each other with the board member accommodating portion of the insulated housing provided between the first and second portions, and

wherein the contact point provided on the resilient arm portion extending from the fixable portion of each of the first contacts and the locking portion provided on the resilient arm portion extending from the fixable portion of each of the second contacts are placed on the side of the second portion of the insulated housing, and the contact point provided on the resilient arm portion extending from the fixable portion of each of the second contacts and the locking portion provided on the resilient arm portion extending from the fixable portion of each of the first contacts are placed on the side of the first portion of the insulated housing.

2. A circuit-terminal connecting device according to claim **1**, wherein the board member accommodating portion has an opening portion opened into a direction perpendicular to a surface of the main circuit board on which the insulated housing is fixed and the reinforcing board member accompanied with the reinforced portion of the flat circuit member is accommodated in the board member accommodating portion through the opening portion of the board member accommodating portion.

3. A circuit-terminal connecting device according to claim **1**, wherein the board member accommodating portion of the insulated housing is provided with a plurality of slits, in each of which the resilient arm portion of the first contact is put.

4. A circuit-terminal connecting device according to claim **1**, wherein the first portion of the insulated housing is provided with a plurality of first slits, in each of which the locking portion provided on the resilient arm portion extending from the fixable portion of the first contacts is put, and the second portion of the insulated housing is provided with a plurality of second slits, in each of which the locking portion provided on the resilient arm portion extending from the fixable portion of the second contacts is put.

* * * * *